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Living Light: Uniting biology and photonics – A memorial meeting in honour of Prof Jean-Pol Vigneron

Living Light 2014 editorial: Photonics from living materials

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Light plays a fundamental role in biology. It allows living beings to see and to recognize themselves. Recognition between species often goes beyond simple shape recognition, for light can convey important additional information. Often of pigment origin, but then of little variety, the color of a bird feather, a butterfly wing or the shell of a beetle may be structural. The microscopic texture of beards, feathers or scales produce special coloration effects by multiple reflections or diffraction of light, most often characterized by iridescence and, more generally, goniochromism. The tour de force of nature is to have been able to produce dramatic lighting effects from biological materials whose refractive index varies in a narrow range only. More than in the composition, the color secret lies in the geometry, often multi-scale, of the structure involved.

In addition to static structural coloration, nature has led to animals that change color under the influence of stress and others that emit light. Whereas the source of the light emitted by a firefly is of biochemical origin, its propagation and its extraction out of this organism may resort to complex physics whose study can help us to improve the efficiency of existing opto-electronical devices. These few examples demonstrate that bio-photonics is more than a passion. It is a multi-disciplinary science whose outcome can be significant for technology. The scientists involved in this science, be they chemists, biologists or physicists, are able to explain natural phenomena on the basis of complicate reactions, detailed microscopic analysis or sophisticated calculations. In return, the studied structures may become a real source of inspiration for the optimization of optical devices, the making of new

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materials and the design of multi-functional surfaces. This is the object of bio-inspiration.

The wings of the Morpho are a beautiful example of natural photonic structures that engineers manage to reproduce with artificial materials. By comparison, biological structures are less perfect, but still, the colorations they produce are robust against imperfections. In some cases, structural color light is circularly polarized in one way or the other, depending on wavelength. If one can explain why, a different issue is to understand for what biological purpose, if any, it is so. Other interesting topics are covered by the papers that follow. All together, they constitute a written, partial witness to the high-quality scientific content of the meeting "Living light 2014" that was organized in the University of Namur in April 2014. "Living light 2014" came after the "Workshop on Bio-Inspired Photonic Structures" in Donostia - San Sebastián, the Basque Country (July 2009) and the "International Symposium on Natural Photonic Structures" in Shanghai, China (June 2011). The Namur meeting was a tribute to the memory of Jean-Pol Vigneron whose great love of understanding the colors of light will be perpetuated by these proceedings.

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